

**ENVIRONMENTAL RESTORATION PROGRAM**

**SOUTH BASE FEASIBILITY STUDY**

**OPERABLE UNIT NO. 2**

**EDWARDS AIR FORCE BASE**

**CALIFORNIA**

**AUGUST 2005**

**FINAL**

**Prepared for**

**U.S. AIR FORCE 95<sup>th</sup> AIR BASE WING  
ENVIRONMENTAL RESTORATION BRANCH (95 ABW/CEVR)  
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**and the**

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## **EXECUTIVE SUMMARY**

A Feasibility Study (FS) was conducted to evaluate remedial alternatives for eight sites (Sites 5, 14, 29, 69, 76, 81, 86, and 102) located at South Base, Operable Unit No. 2 (OU2), Edwards Air Force Base, California. Based on the contaminants of concern and the potential exposure pathways identified through the risk assessment process, remedial action objectives for each site were identified during the FS. The next phase of the FS process was the identification, development, and screening of remedial alternatives that may be implemented to achieve the long-term cleanup goals at the sites. This FS utilized the Superfund Accelerated Cleanup Model, which includes the use of presumptive remedies where applicable.

### **Sites 5/14 Contaminant Plume**

Site 5 (the Former South Base Waste Petroleum, Oil, and Lubricant Storage Area) and Site 14 (the South Base Fire Fighting Training Facility) were evaluated during this FS as a single site, the Sites 5/14 Contaminant Plume. The Sites 5/14 Contaminant Plume is a commingled fuel and solvent plume that originates in the southern portion of Site 5. The plume extends approximately 5,600 feet southeasterly and ends at Site 14.

At the Sites 5/14 Contaminant Plume, the long-term cleanup goal is to return the groundwater to beneficial use (i.e., reduce the contaminant concentrations to levels below the primary maximum contaminant levels [MCLs]). Therefore, the following four remedial alternatives were evaluated in detail:

- Alternative 1 – No Action
- Alternative 2 – Containment (Hydraulic capture of downgradient groundwater, treatment of extracted groundwater with carbon adsorption, reinjection of treated groundwater, long-term monitoring [LTM], and institutional controls)
- Alternative 3 – Source Removal and Containment (Hydraulic capture of downgradient groundwater, free-product recovery with dual extraction wells, groundwater treatment with oil/water separation, air stripping, and carbon treatment, off-site disposal of product, thermal/catalytic vapor treatment, discharge of treated groundwater to a federally-owned treatment works [FOTW], LTM, and institutional controls)

- Alternative 4 – In Situ Treatment (Maintenance of containment, LTM, and institutional controls [see Alternative 2] during treatment and pilot testing, evaluation of treatment options through pilot testing [aerobic biological degradation for the source area, aerobic cometabolic degradation and in situ chemical oxidation [ISCO] using potassium permanganate for the dissolved chlorinated plume], evaluation of pilot test results, application of selected technology). To evaluate the cost implications based on the possible outcomes of the pilot testing for Alternative 4, the following sub-alternatives will be considered:
  - Sub-alternative 4a – Aerobic biological degradation of entire plume
  - Sub-alternative 4b – Aerobic biological degradation of the source area, ISCO of the dissolved chlorinated plume
  - Sub-alternative 4c – Free-product recovery with dual extraction wells, ISCO of the dissolved chlorinated plume.

Based on the detailed evaluation of alternatives, the implementation of Alternative 4 at the Sites 5/14 Contaminant Plume is recommended. Sub-alternatives 4a and 4b assume biosparging would effectively remediate the entire plume and the floating free-product, respectively. Sub-alternative 4c assumes the floating free-product in the plume can be effectively recovered. Sub-alternatives 4b and 4c also assume that ISCO using horizontal wells would effectively remediate the dissolved chlorinated portion of the plume. However, Sub-alternatives 4b and 4c would only be cost effective if a pilot test confirms the effectiveness of ISCO. Sub-alternatives 4a and 4c have high estimated escalated costs for the benefit received (i.e., risk reduction), and are not recommended for implementation. Therefore, Sub-alternative 4b is recommended for implementation. Assuming implementation would begin in 2007, the estimated escalated cost for Sub-alternative 4b at the Sites 5/14 Contaminant Plume is \$7,280,000.

If the pilot tests at the Sites 5/14 Contaminant Plume prove unsuccessful, the plume containment and institutional control phases of Sub-alternative 4b would continue to be implemented, along with an extraction method to address the free-product (source area). The extraction method could include, but not be limited to, mobile free-product recovery.

## **Sites 76 and 86**

Groundwater contaminated with trichloroethene (TCE) is the primary concern at Site 76 (the Old South Base Assorted Facilities) and Site 86 (the Building 300 Engine Test Cell). During this FS, Sites 76

and 86 were usually evaluated together because of the similarity in site conditions and contaminants (i.e., the low concentrations of TCE dissolved in the groundwater).

At Sites 76 and 86, the long-term cleanup goal is to return the groundwater to beneficial use (i.e., reduce the TCE concentrations to levels below the primary MCL). Therefore, the following four remedial alternatives were evaluated in detail:

- Alternative 1 – No Action
- Alternative 2 – Institutional Controls including LTM
- Alternative 3 – Active Groundwater Restoration (Ex Situ Treatment) – Groundwater extraction, treatment of extracted groundwater with carbon adsorption, reinjection of treated groundwater, and institutional controls during operation
- Alternative 4 – Active Groundwater Restoration (In Situ Treatment) - Evaluation of treatment options through pilot testing, in situ treatment (ISCO by potassium permanganate and anaerobic biodegradation), and institutional controls during treatment. To evaluate the cost implications based on the possible outcomes of the pilot testing for Alternative 4, the following sub-alternatives were considered:
  - Sub-alternative 4a – Anaerobic biological degradation
  - Sub-alternative 4b – ISCO.

Based on the detailed evaluation of alternatives, the implementation of Alternative 4 at Sites 76 and 86 is recommended. This alternative includes implementing and maintaining institutional controls, LTM, and conducting pilot tests to evaluate two in situ treatment technologies: anaerobic biological degradation (Sub-alternative 4a) and ISCO (Sub-alternative 4b). The actual treatment implemented would depend upon the outcomes of the pilot tests evaluating the effectiveness of the in situ treatment technologies.

Although the estimated escalated cost for Sub-alternative 4a is comparatively high, it should not be ruled out prior to the completion of the pilot test, which is scheduled for 2005. The pilot test may indicate that fewer wells are required than were estimated, thereby lowering the cost of this sub-alternative. However, because Sub-alternative 4b has the lowest estimated escalated cost, its implementation is recommended (pending the outcome of the ISCO pilot test). Assuming

implementation would begin in 2007, the estimated escalated costs for Sub-alternative 4b at Sites 76 and 86 are \$770,000 and \$1,194,000, respectively.

If the pilot tests for Sub-alternatives 4a and 4b at Sites 76 and 86 are unsuccessful, Alternative 2 (institutional controls and LTM) would be implemented, and other remedial options will be evaluated.

## **Site 29**

Site 29 (the South Base Abandoned Sanitary Landfill) consists of two former landfill areas; a western landfill area reportedly active during the late 1930s, and an eastern landfill area reportedly active from the 1950s to the 1970s. Municipal-type solid waste was deposited at the landfill areas using the cut-and-cover method of waste disposal. More recently, construction rubble consisting mainly of large broken pieces of concrete and asphalt was placed on the ground surface at the eastern landfill area. The primary concern at Site 29 is the buried solid waste. Carcinogenic and noncarcinogenic risks to site workers and ecological receptors were evaluated to be within acceptable limits. Groundwater contaminants do not exceed MCLs.

At Site 29, the long-term goal is to minimize the potential for contaminant migration to the deep groundwater aquifer (identified by the State of California as a potential drinking water source), and to prevent potential receptors from coming in direct contact with the landfill wastes. The presumptive remedy for landfills (containment) is believed to be applicable to Site 29. The following four remedial alternatives were evaluated in detail:

- Alternative 1 – No Action
- Alternative 2 – Institutional Controls, Stormwater Controls, and LTM
- Alternative 3 – Removal of Recently Emplaced Surface Debris, Institutional Controls, Stormwater Controls, and LTM
- Alternative 4 – Engineered Landfill Cover, Institutional Controls, and LTM.

Based on the detailed evaluation of alternatives, Alternative 3 is the recommended remedial action for Site 29. Assuming implementation would begin in 2007, the estimated escalated cost for Alternative 3 is \$4,427,000.

## **Site 69**

Site 69 (the Old South Base North Landfill) was reportedly used as a landfill for general debris as early as the 1940s. The surface of the landfill is currently covered with scattered rusted cans, broken glass, metal wire, and railroad debris. A geophysical survey conducted at the site delineated several anomalies indicative of subsurface deposits (i.e., buried solid waste). The primary concern at Site 69 is the buried debris. Carcinogenic and noncarcinogenic risks to site workers and ecological receptors were evaluated to be within acceptable limits. Groundwater contaminants do not exceed MCLs.

At Site 69, the long-term goal is to prevent potential receptors from coming in direct contact with landfill wastes. Therefore, the following four remedial alternatives were evaluated in detail:

- Alternative 1 – No Action
- Alternative 2 – Institutional Controls
- Alternative 3 – Removal and On-Base Waste Disposal of the Buried and Surface Debris (Consolidation at Site 29)
- Alternative 4 – Removal and On-Base Waste Disposal of the Buried and Surface Debris (Consolidation at the Main Base Active Landfill).

Based on the detailed evaluation of alternatives, Alternative 4 is the recommended remedial action for Site 69 even though its escalated cost is slightly higher than the cost of Alternative 3. Alternative 4 is recommended because it has a lower overall cost when the cost for the creation of a Corrective Action Management Unit (CAMU) at Site 29 is considered. Assuming implementation would begin in 2007, the estimated escalated cost of Alternative 4 is \$280,000.

## **Sites 81 and 102**

Site 81 (the Old South Base Northern Skeet Range) and Site 102 (the Old South Base Southern Skeet Range) were used as small arms/skeet ranges during the 1940s and 1950s. Lead shot pellets and black clay fragments of broken skeet targets are visible on the ground surface at each site. The primary concern at these sites is the skeet fragments, which are contaminated with polynuclear aromatic hydrocarbons (PAHs) (also called polycyclic aromatic hydrocarbons).

At Sites 81 and 102, the long-term goal is to prevent potential receptors (especially animal receptors) from coming in direct contact with the skeet shards contaminated with PAHs. Therefore, the following three remedial alternatives were evaluated in detail:

- Alternative 1 – No Action
- Alternative 2 – Removal and On-Base Waste Disposal of the Skeet Fragments (Consolidation at Site 29 CAMU)
- Alternative 3 – Removal and Off-Site Treatment or Recycling of the Skeet Fragments.

Based on the detailed evaluation of alternatives, Alternative 3 is the recommended remedial action for Sites 81 and 102 because of the lower overall cost when the creation of a CAMU at Site 29 is considered, and it has the least potential for impact to the desert ecosystem. Assuming implementation would begin in 2007, the estimated escalated cost of Alternative 3 is \$259,000.